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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/160,965

09/25/1998

SHAU-LIN SHUE

TSMC97-542/9

6951

7590

08/12/2002

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EXAMINER

KIELIN, ERIK J

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 08/12/2002

24

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/160,965

Applicant(s)

SHUE ET AL.

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 July 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4,6 and 10-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4,6 and 10-12 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 20 May 2002 is: a) ☐ approved b) ☒ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8 July 2002 has been entered.

Drawings

2. The proposed drawing correction and/or the proposed substitute sheets of drawings, filed on 10 May 2002, have been disapproved because they introduce new matter into the drawings. 37 CFR 1.121(a)(6) states that no amendment may introduce new matter into the disclosure of an application. The original disclosure does not support the showing of the capping layer over the entire surface of the substrate or extending beyond the copper fill-- as presently shown in the proposed corrections of Fig. 2h and 3g. The specification indicates that the copper damascene is capped -- not the whole of the substrate or parts of the substrate.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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4. Claims 1-2, and 4, 6, 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Lin** (US 6,093,656) in view of **Rathore et al.** (US 6,069,068) and **Datta et al.** (US 5,567,300).

Lin discloses the silicon substrate 12, the damascene trenches 13, 14 in a dielectric layer, the barrier metal layer (column 3, lines 17-23); the copper layer 20 (or “conductor,” claim 1); the reverse tone photoresist mask 26 which covers the copper in the trenches (column 3, lines 32-57; Fig. 3); etching the exposed copper portions down to the silicon using a wet etch (Fig. 4; column 4, lines 15-21); stripping the photoresist (column 4, lines 22-25); planarizing the copper by CMP (column 4, lines 27-29). See also columns 1-4 and all figures.

Lin does not (1) specifically use the terminology, “dual damascene” or show a dual damascene structure in the figures, (2) does not specifically state that the disclosed “blanket copper deposition” (column 3, line 24) is electroplating on a seed layer; (3) reverse current electroplating; or (4) the cap layer.

Regarding (1), aside from it being known in the art that dual damascene (as opposed to single damascene) is also subject to dishing during metal planarization and for the same reasons, **Lin**’s claim 1 indicates the damascene, dielectric trenches have “at least two levels of elevation.” A third level of elevation would clearly yield a dual damascene trench structure. Therefore, **Lin** implicitly defines the invention for dual damascene. Note that it has been held that “[I]n considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom.” *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968) See also *In re Lamberti*, 545 F.2d 747, 750, 192 USPQ 278, 280 (CCPA 1976). Therefore,

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dual damascene is at least implicitly disclosed as being incorporated both in **Lin**'s inclusive claim language and in that fact that dual damascene is notoriously well known in the art, especially as defined in the **Lin** claims.

Regarding (2) and (4), although **Lin** does not specifically state electroplating is used for filling, **Lin** does teach that the blanket deposition of copper "could be done in a number of different ways..." (column 3, lines 23-27). **Rathore** teaches that it is known in the art to fill a dual damascene pattern using electroplating of copper on the stack consisting of adhesive layer 5, barrier layer 6, and seed layer 8 followed by planarization of the electroplated copper layer 9 and said stack (column 2, lines 45-59; Fig. 1a) and finally depositing a cap layer 7, 10 to seal the copper. (See Figs. 6b-6d.) Note also the **Rathore** states that "electroplating of copper **requires** a copper seed layer" (column 2, lines 3-5; emphasis added).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use any conventional copper electroplating on a required seed layer for the reason given in **Lin** because **Lin** teaches blanket depositing which clearly indicates to one of ordinary skill that **any** blanket depositing method is appropriate, such as the electroplating of **Rathore**.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the cap layer for the reasons indicated in **Rathore**.

Regarding (3), **Datta** et al. and references cited therein teach the benefits of reverse current electroplating for the purpose of removing unwanted metal -- particularly copper -- regions for the purpose of planarizing (sections entitled "Planarization is desirable for two reasons" and "There are various planarization methods").

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify **Lin** in view of **Datta** for the reasons given in **Datta**.

Regarding claim 4, in claim 1 of **Lin**, the layer 20 is limited to only “conductors” and therefore makes the use of any of Applicant’s claimed conductors obvious. It has been held that selection of a known material based on its suitability for its intended use is *prima facie* obvious.

Regarding claim 6, **Lin** does not indicate that the dielectric is silicon oxide, but it is known to use silicon oxide for the dielectric in damascene processes and is therefore obvious to one of ordinary skill to use as a matter of routine material choice. See *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960). The choice of silicon oxide for **Lin**’s dielectric; Au, Al, with, Ti, or Ag for **Lin**’s conductor; and are obvious as amounting obvious material choice, well within the purview of those of ordinary skill, as per the precedent above.

Regarding claims 11-12, **Lin** makes clear the inherency of or alternatively suggests Applicant’s “critical dimensions” in the **Lin** discussion of the reverse tone photoresist mask. The choice of critical dimensions is obvious as a matter of routine optimization. These claims are *prima facie* obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

Response to Arguments

5. Applicant's arguments filed 1/24/02 have been fully considered but they are not persuasive.

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Applicant argues, in quoting the passage quoted in **Lin** by Examiner in the rejection above, that the Lin statement “that the blanket deposition of copper ‘could be done in a number of different ways...’ in no way teaches anything.” Examiner expressly disagrees. It specifically tells those of ordinary skill in the art that (1) “a number of different ways” are appropriate for deposition of copper which implicitly means any art known method such as the notoriously well known electroplating and (2) that the invention of Lin is not to be limited by the exemplary method used therein. Applicant’s argument is quite simply without merit.

Applicant continues arguing in this regard that “It appears to Applicant that Lin is then teaching away because nobody after Lin could then suggest any other way of blanket deposition of copper.” Again, Examiner expressly disagrees. This assertion directly contradicts the express statement in Lin that the blanket deposition of copper “could be done in a number of different ways.” How then could this “teach[] away” from the use of other methods? Applicant’s argument not only blatantly ignores the express teaching of Lin, but also defies common sense in its assertion. This argument is wholly without merit.

Applicant’s argument that Rathore “strictly addresses the filling and planarization of copper interconnections.” Rathore was provided at least to show such copper filling and planarization making its combination with Lin who discloses **global** planarization of interconnections appropriate. Accordingly, Applicant’s argument in this regard is moot.

Applicant does not appear to provide an argument regarding the cap layer. The cap layer provided in the proposed drawing corrections introduces new matter. The capping layer in no way affects the planarization anyway because it occurs after the planarization and can therefore not have any causal impact. The cause necessarily precedes the effect. Nonetheless, Rathore

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teaches the capping layer, making any argument in this regard moot. Examiner, accordingly, disagrees that there is anything unique about the instant invention.

Regarding Applicant's statement "that Datta et al. teaches reverse electroplating and its benefits, including various planarization methods" Examiner agrees that this is what Datta teaches and why one of ordinary skill would be motivated to apply the teachings therein to copper damascene planarization. Examiner disagrees that Applicant has provided any improvement not already taught and suggested by the applied art.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Fiordalice et al., US 5,578,523, at column 1, line 59 to column 2, line 27, teaches that the causes of dishing in single damascene are the same as those in dual damascene.

Bernhardt et al. (US 5,256,565) teaches reverse current electroplating to planarize damascene copper electroplated onto a seed layer.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached at (703) 306-2794 or by e-mail at

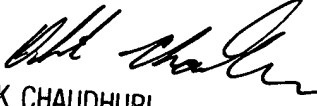
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olik.chaudhuri@uspto.gov. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

EK

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August 8, 2002


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